NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

FUNDING CONSIDERATIONS FOR MATERIAL
MANAGED BY THE
NAVAL ELECTRONIC SYSTEMS COMMAND

by

Gary D. Lynn

June 1979

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20. (continued)

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Funding Considerations for Material Managed by the Naval Electronic Systems Command

by

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TABLE OF ABBREVIATIONS

AM	Acquisition Manager
ASO	Aviation Supply Office
ASU	Approval for service use
BESEP	Basic Electronics Shore Equipment Plan
CASREPT	Casualty Report
CENILE	Cumulative End Item Ledger
CNM	Chief of Naval Material
CNO	Chief of Naval Operations
COG	Cognizance Symbol
DOP	Designated Overhaul Point
ETE	Electronic Test Equipment
EW	Electronic Warfare
FIRM	Fleet Intensified Repairables Program
FMP	Fleet Modernization Program
FMS	Foreign Military Sales
GPETE	General Purpose Electronic Test Equipment
HSC	Hardware Systems Command
ICP	Inventory Control Point
IFF	Identification Friend or Foe
ILSP	Integrated Logistics Support Plan
IM	Inventory Manager
IRAM	Improved Repairables Asset Management
MCC	Material Control Code
MDF	Master Data File
MILSTEP	Military Supply and Transportation Evaluation Procedures

MIPR	Military Interdepartmental Procurement Request
MTBF	Mean Time Between Failures
NAVAIR	Naval Air Systems Command
NAVELEX	Naval Electronic Systems Command
NAVFAC	Naval Facilities Engineering Command
NAVILCO	Navy International Logistics Control Office
NAVMAT	Naval Material Command
NAVSEA	Naval Sea Systems Command
NAVSUP	Naval Supply Systems Command
NIIN	National Item Identification Number
NPFC	Navy Publications and Forms Center
NRFI	Not-ready-for-issue
NSN	National Stock Number
NTDS	Navy Tactical Data System
O&MN	Operations and Maintenance, Navy
OPN	Other Procurement, Navy
OSD	Office of the Secretary of Defense
PLT	Procurement Lead Time
POM	Program Objectives Memorandum
PPBS	Planning, Programming and Budgeting System
PPR	Planned Program Requirement
RDT&E	Research, Development, Test and Evaluation
RFI	Ready-for-issue
RTAT	Repair Turn-around Time
SAMIS	Ship Alteration Management Information System
SCN	Shipbuilding and Conversion, Navy
SECNAV	Secretary of the Navy

SMA	System Material Availability
SR	Survival Rate
SPCC	Ships Parts Control Center
SPD	Ships Project Directive
SPETE	Special Purpose Electronic Test Equipment
STRAT	Stratification
SYSCOMS	Systems Commands
UICP	Uniform Inventory Control Point
UR	Unplanned Requirement
UUR	Unfunded, Unplanned Requirement

I. INTRODUCTION

A. INTENT

Theses by McCarthy, et al. (4), Pettersen and Casey (15), and Seebeck (16) examined various aspects of the inventory management function performed by the Naval Electronic Systems Command (NAVELEX). These theses identified specific inventory management problems that faced NAVELEX as a consequence of funding constraints and interpretation of inventory management responsibilities imposed by higher authority. A subsequent thesis by Hanson (2) addressed the impact of the budgeting constraint on repairable secondary items managed by NAVELEX.

The research for the present thesis examined the conflict between higher authority's perspective of what types of material NAVELEX should manage and the types of material actually managed by NAVELEX. The intent of this thesis was to assess the causes of the conflict and the impact of that conflict in terms of budget constraints and subsequent inability to meet material demands.

B. APPROACH

The approach for conducting the research for this thesis was to establish the organizational relationships within which NAVELEX works, identify NAVELEX's assigned inventory management responsibilities, determine the inventory characteristics of material managed by NAVELEX, identify the funding constraints imposed by higher authority upon NAVELEX and the process by which NAVELEX projects funding requirements for inventory assets, and assess the impact of the extant funding policy

upon NAVELEX's ability to meet demands for NAVELEX managed materials. The methodology for conducting the research was to review applicable directives and written material, review and analyze demand history data for NAVELEX managed items, and to conduct interviews by telephone or in person with personnel from NAVELEX, the Naval Material Command, and the Office of the Chief of Naval Operations.

II. BACKGROUND

A. ORGANIZATIONAL RELATIONSHIPS AND RESPONSIBILITIES

The Chief of Naval Operations is supported by a staff assigned to the Office of the Chief of Naval Operations (OPNAV). Within OPNAV, responsibility for major programs to develop new and/or improved weapons systems is assigned to senior officials designated as Resource Sponsors. OPNAV Resource Sponsors coordinate the development, scheduling, introduction to operational use, and funding of new weapon systems and related equipment to support approved Navy programs.

The Naval Material Command was established on 1 May 1966, pursuant to the Secretary of Defense Reorganization Plan transmitted to Congress on 10 March 1966. In accordance with SECNAV Instruction 5400.13 of 24 August 1971, the Chief of Naval Material (CNM) is directly subordinate to the Chief of Naval Operations (CNO). (10)

OPNAV Instruction 5450.176 of 6 August 1969 states that the mission of the Naval Material Command (NAVMAT) is, inter alia, to meet the system and material support needs of the Operating Forces of the Navy for equipment, weapons and weapons systems, materials, supplies, facilities, and maintenance and supporting services consistent with approved programs. (10)

The CNM has delegated these material support responsibilities to five Systems Commands (SYSCOMS). As of 1 May 1979

these were the Naval Sea Systems Command (NAVSEA), the Naval Air Systems Command (NAVAIR), the Naval Electronic Systems Command (NAVELEX), the Naval Facilities Engineering Command (NAVFAC), and the Naval Supply Systems Command (NAVSUP). NAVSEA, NAVAIR, and NAVELEX are commonly referred to as Hardware Systems Commands (HSC) because each is responsible for the research, development, design, evaluation, acquisition, installation, logistics, and technical support and guidance for a particular class of weapons systems and equipment related to the weapons systems. (4:63)

To fulfill its assigned responsibilities NAVELEX has established organizational components aligned by general mission orientation of electronic systems, such as command, control and communications systems; and undersea surveillance systems. These organizational units are termed Project Offices and are headed by a Project Manager. Within NAVELEX, Project Offices are referred to as PMEs.

In addition to the PMEs, NAVELEX has established functionally oriented organizational components that have been designated as Directorates. The Directorates provide support to the PMEs and perform the functional tasks required to discharge NAVELEX's responsibilities. For purposes of this thesis, the Directorates of principal interest are the Planning, Programming and Resources Management (ELEX 01), Logistics (ELEX 04), and Material Acquisition (ELEX 05) Directorates. These Directorates are concerned with the funding, logistics planning, acquisition, technical engineering and control, and

inventory management of specified electronic systems and equipment developed and introduced for operational use under the auspices of the PMEs and OPNAV Resource Sponsors. A more detailed description of the NAVELEX Directorates is provided in Appendix A.

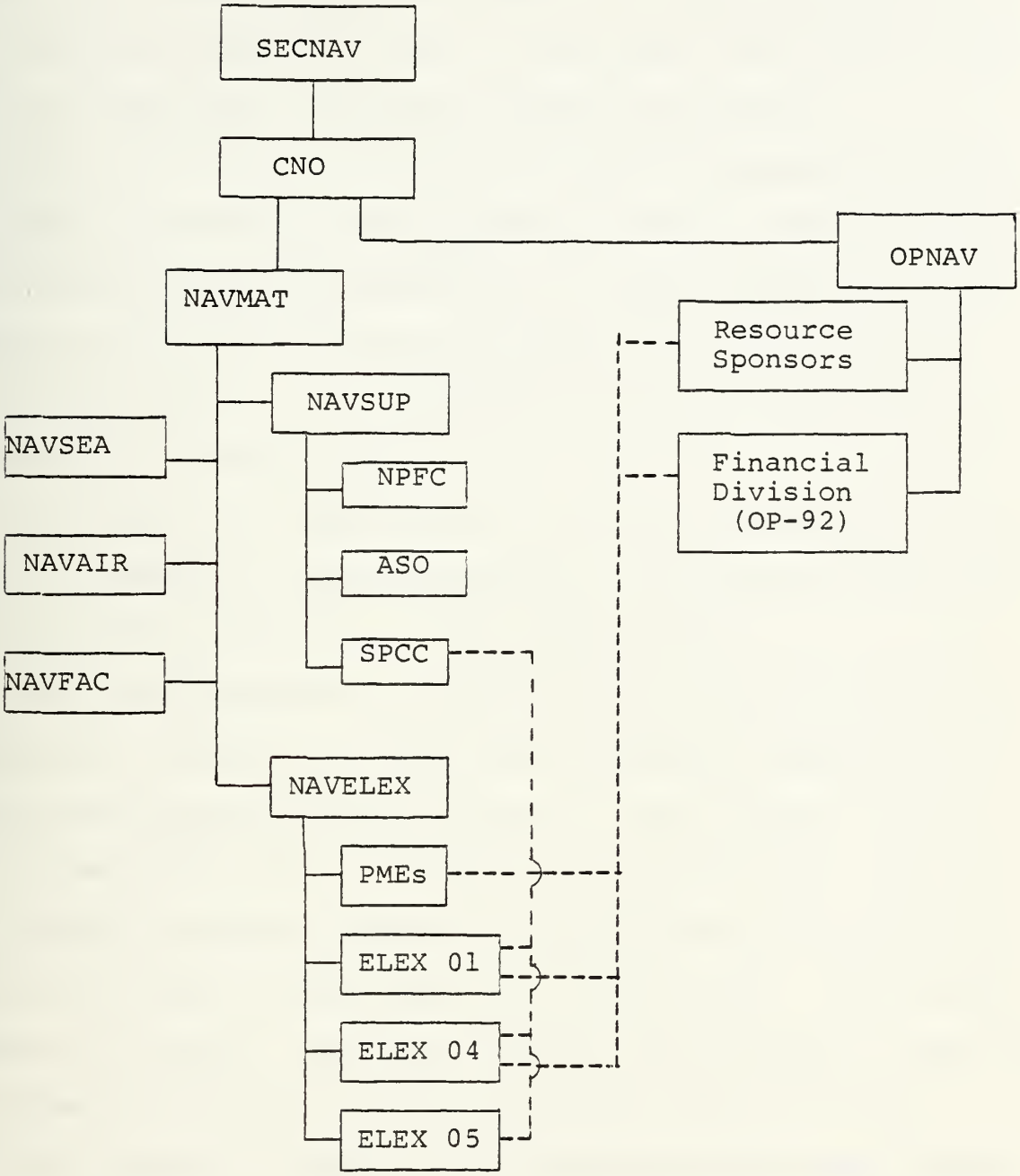
NAVSUP has been charged by CNM with the responsibility of providing supply management policies and methods for Navy material which is not specifically assigned to other commands for centralized inventory control. This responsibility includes provisioning, cataloging, inventory management, transportation, packaging, preservation, receipt, storage, issue and disposal functions. (7:22) To perform the provisioning, cataloging, and inventory management functions, NAVSUP has three Inventory Control Points (ICP): Aviation Supply Office, Philadelphia (ASO); Ships Parts Control Center, Mechanicsburg (SPCC); and Navy Publications and Forms Center, Philadelphia (NPFC). ASO and SPCC manage the hardware-related material and NPFC manages only forms and publications. In the process of providing material support through provisioning and inventory management ASO and SPCC communicate regularly with the NAVELEX Directorates.

The organizational relationships described in this section are shown in Figure 1.

B. INVENTORY MANAGEMENT OF NAVY MATERIAL

Navy policy prescribes that there shall be only one inventory manager for each item (equipment, component, or repair part) within the Navy. This policy provides that inventory

Figure 1 - Organizational Relationships[1]



____ Administrative line of authority

---- Lines of interorganization communications/liaison

[1]This organization chart depicts only those organizational elements pertinent to this study. It does not show the complete organizational structure for any of the commands or subunits.

management of Navy material will normally be assigned to a NAVSUP ICP. Accordingly, the number of items managed by an HSC should be relatively few. To implement this policy, NAVMAT has established the Stock Coordination Program.

Stock coordination is an administrative process by which an item is assigned to one inventory manager. Stock coordination commences with the approval of a weapon system or weapon support system and continues until the weapon system is removed from service. The objectives of stock coordination include the following (11):

(1) Prevent the duplication of inventory management effort.

(2) Concentrate supply management functions for Navy material under the cognizance of the NAVSUP ICPs.

Despite the emphasis on the use of the ICPs for inventory management, the HSCs are authorized to manage inventories of designated hardware-related material. The division of material between the ICPs and NAVELEX (or any other HSC) crosses all material classes and is essentially based on the type of control that must be exercised over the material. The terms "technical control" and "stock control" can be used to identify two types of inventory control applied to Navy material.

When technical control is the dominant requirement, inventory management is generally performed by an HSC, provided the material meets one or more specific criteria established by the CNM. (4:65-66)

NAVMAT has directed that items managed by an HSC, or their field activities, will be limited to items meeting one or more of the following criteria (8):

(1) Items in a research and development stage. Items qualifying under this criterion must be under development and not yet in Fleet operational use.

(2) Items requiring engineering control decisions. This criterion is applicable when a high degree of engineering judgement is required concerning design or relationships to a system. It pertains principally to those items requiring engineering decisions during production or prior to each issue. Items that remain in this category after two years of operational use must be justified in the same manner as criteria (4) items.

(3) Items unstable in design. Items which are determined by an engineering decision to be highly subject to design change of the item itself, or replacement of the item through modification of its next higher assembly. End items, components, assemblies, and test and evaluation equipment that are unstable in design do not automatically exclude their intrinsic parts from stock coordination review. Items retained for management at an HSC under this criterion will be transferred to an ICP after two years of operational use unless a major design change or modification has been approved and/or is being accomplished at the time of the Stock Coordination Review. Further retention upon completion of an approved design change or modification must be justified in accordance with criteria (4) below.

(4) Items expressly assigned to a single command for management by a separate authorizing NAVMAT directive. Items

qualifying under this criteria are limited to items of major importance and depot level repairables. Inclusion in this category requires a CNM decision based upon justifying rationale submitted by the originating command. As a general rule, items changed from criterion (2) and from criterion (3) above into this criterion will be transferred to an ICP for inventory management, even though the procurement function remains at the HSC level. Items assigned under this criterion will be considered as an adjunct to stock coordination and, therefore, are not precluded from formal review when scheduled.

Inventory management responsibility is identified by the assignment of a two position numeric-alpha code referred to as a cognizance symbol. Thus, material retained by NAVELEX for inventory management is assigned a cognizance symbol of 2Z. Electronic material managed by SPCC is assigned cognizance symbols of 1H, 2H, 4A, 4G, 4N, 40, or 6G, as applicable. A detailed description of electronic equipment cognizance symbols and inventory management responsibilities is provided in Appendix B.

In accordance with the CNM criteria for items managed by an HSC, NAVELEX assumes inventory management responsibilities for specifically designated, newly developed electronic equipment as it progresses from the initial design stage through the production and installation stages. Between the design stage and the production stage, the NAVELEX Acquisition Manager (AM) prepares a list of major equipment/components of a new system. This list is submitted to the Supply Plans and

Program Branch (ELEX 5042) where the cognizance symbol 2Z is assigned to the items, as deemed appropriate. (It has been customary for any major electronic equipment or component being developed under NAVELEX's cognizance and funded by NAVELEX to be designated as 2Z.) After the 2Z cognizance symbol (Cog) has been assigned, the AM's list is forwarded to SPCC for cataloging and assignment of a National Item Identification Number (NIIN).

The above process accounts for the majority of 2Z cognizance symbol assignments, however, during the provisioning process at SPCC additional components may be assigned a 2Z cognizance symbol.

Once an item has been designated as 2Z it will remain a NAVELEX managed item until it is formally transferred to another activity, normally SPCC, for inventory management. To recognize a change in inventory managers, an item transferred from NAVELEX to SPCC changes its cog from 2Z to 4G, in most cases. Transfers of inventory management responsibility occur as the result of stock coordination reviews required by the Stock Coordination Program. An annual review of items managed by each HSC is made on an item-by-item basis to determine if items no longer meet the NAVMAT criteria for retention by the HSC. Items which do not meet the CNM criteria for HSC management are required to be transferred to the appropriate ICP.

C. CATEGORIES OF NAVY MATERIAL

The CNO has categorized Navy material into two broad types: principal items and secondary items. CNO has defined principal items as those items which exhibit the following traits (2:33):

(1) Item requirements are determined on a planned basis by the cognizant HSC.

(2) Item requirements are based solely on planned end-use allowances and planned reserve/retention requirements.

(3) Budget formulations for the item are done separately through Materiel Planning Studies and Principal Item Stratifications.

(4) The item is procured with appropriated investment funds.

(5) The item requires replacement only due to major or total destruction, intended destructive use, or planned retirement.

(6) Issues to end-use are limited to HSC-established allowances or special HSC-approved authorization.

The CNO's definition for principal items emphasizes the planned nature of requirements and the basis for replacement as only major or total destruction, not component failure.

The CNO has defined secondary items as items not classifiable as principal items and which possess the following characteristics (2:33-34):

(1) Requirements are determined by the cognizant ICP.

(2) Requirements are based either on estimated and/or observed demands, or non-demand based insurance levels.

(3) Budget formulations are based upon standard levels-setting techniques and standard Secondary Item Stratification projections.

(4) Procurement is financed with either investment funds or stock funds, as governed by such factors as unit price and recoverability.

(5) Replacement is based primarily on normal in-service wearout or consumption.

(6) Issues to end-use are subject to limitation on the basis of established allowances, but more typically are limited only on the basis of quantitative validations.

In contrast to principal items, the CNO's definition of secondary items emphasizes requirements based on demand and replacement due to component/item failure through use.

The classification "secondary item" is a broad category which covers spare parts (or spares), repair parts, and consumable supplies. Spares are generally complex, high value components/units of a larger equipment that are designed to be repaired. Repair parts are usually of low complexity, are generally not of high value, and are not designed to be repairable. That is, when a repair part fails, it is intended to be discarded and a replacement obtained. Consumables are general supplies which are normally consumed during use. (12)

D. FUNDING OF NAVY INVENTORIES

Inventories of Navy material are classified for funding purposes into two principal categories, as investment or as expense items. For budgetary purposes expenses are defined

to include material consumed in use except when it is consumed in the production or construction of investment items. In this context, consumable type material includes (14):

(1) End items of equipment when the unit value is less than $1,000 and an inventory control point does not maintain centralized individual item management down to the user level.

(2) Nonrepairable parts.

(3) Spare assemblies and parts which, although repairable, are not centrally managed, recoverable items. They are not centrally managed because the central inventory manager has determined that repair of unserviceable units will not be considered in budget requirements determination.

(4) Expendable supplies and materials.

Investment items are defined as those items associated with the acquisition of equipment. Specifically, included as investment items are the following (14):

(1) Major end-items of equipment that are subject to continuing, centralized, individual item management, and asset control throughout their active life. Typically, such items are long-lived, of high dollar unit value, and repairable.

(2) Other end-items of equipment except items of equipment having a unit value of less than $1,000, and over which an inventory control point does not maintain centralized item management throughout the supply system down to the user level.

(3) Spare assemblies and parts that are centrally managed and for which unserviceable quantities are considered by the inventory manager in determining requirements.

Generally, within the constraints of the above definitions, principal items and spares are funded as investment items, and repair parts and consumables are funded as expense items. The only exception to this is the initial outfitting of a major end-item of equipment. For initial outfitting, all items making up the initial on-board load are funded as investment items.

The distinction between investment and expense items is relevant for budgetary purposes since, as a general rule, investment items must be funded from procurement appropriations, such as Shipbuilding and Conversion, Navy (SCN) or Other Procurement, Navy (OPN), and expense items are funded from expense appropriations, such as Operations and Maintenance, Navy (O&MN).

E. THE BUDGETING PROCESS

Funds with which to procure equipment, maintain inventories, and buy the parts and labor necessary to repair spares and repairable principal end-items must be obtained in accordance with the Department of Defense Planning, Programming and Budgeting System (PPBS).

PPBS is a comprehensive set of procedures which provide for a standardized planning and programming system for all the armed services. PPBS can be considered to consist of three phases: a planning phase wherein global threat is assessed and strategy to meet that threat is defined; a programming phase which translates the strategic plans into alternative force structure programs defined in terms of men,

material, and financing; and, a budgeting phase which expresses the programs in terms of annual funding requirements. These three phases are closely interrelated and the calendar year events of planning and programming are timed to conform to the more rigid annual budgeting cycle. (5:50-52)

The final output each year and most significant document in the programming phase is the Program Objectives Memorandum (POM). The Department of the Navy POM is the Secretary of the Navy's annual recommendations for the detailed application of Department of the Navy resources. The Navy POM is submitted by the Secretary of the Navy to the Secretary of Defense. (5:95)

The POM proposes the Navy's force structure (manpower, equipment, and support services) in terms of quantities and costs for the next five years beyond the budget year. (The budget year is the fiscal year for which a budget has been, or is being, formulated for inclusion in the President's budget submission to the Congress.)

The POM process requires each major operating and support command to submit costed requirements for itself and subordinate commands to the OPNAV General Planning and Programming Division (OP-90) for review and inclusion in the Navy POM. Subsequently, during the budget formulation process the major operating and support commands submit budget requests based on the first year of the previous year's approved POM. These budget requests are submitted to the OPNAV Financial Management Division (OP-92). Budget requests for procurement of hardware systems and related equipment are normally

distributed by OP-92 to the OPNAV Resource Sponsors for review and approval/comment. Upon return of these final marked-up budget requests from the Resource Sponsors, OP-92 prepares the Navy budget for submission to the Secretary of the Navy (SECNAV). Once SECNAV approves the budget it is submitted to higher authority for inclusion in the Department of Defense portion of the President's budget submission to the Congress.

Generally, an equipment requirement must have been included in an approved POM before it can be included in the Navy's budget. Since the POM projects costed requirements for five years, there are five opportunities for a requirement to be included and approved. However, inclusion in an approved POM in any one year does not guarantee the requirement will survive subsequent POM or budget reviews.

III. PROBLEM STATEMENT

NAVELEX receives SCN funds from OPNAV Resource Sponsors to procure electronic systems and related equipment for approved new installations. NAVELEX also receives O&MN funds from OPNAV, via NAVMAT, to restore and/or repair electronic equipment which has failed in part. NAVELEX does not receive funds to procure replacements for electronic equipment which has failed in total, or has failed in part but cannot be restored/repaired. This funding policy is consistent with the CNO's definition of principal items and secondary items, which clearly states that principal items are managed by HSCs and secondary items are managed by ICPs. Since principal items do not fail in total and requirements are planned, there is no need to fund replacements of principal items.

Unfortunately, this logic is valid only if the HSCs do, in fact, manage only principal items, i.e., items which do not experience random demand requirements from end users. To the extent that items managed by NAVELEX exhibit secondary item demand characteristics, NAVELEX has a potential inability to satisfy recurring demands.

The magnitude of NAVELEX's inventory shortfall (i.e., no inventory on hand to meet demands) is dependent upon a number of interrelated factors which are presented in the remainder of this thesis.

IV. ANALYSIS

A. INVENTORY MANAGEMENT BY NAVELEX

NAVELEX manages and controls all 2Z cog material. Actual ready-for-issue (RFI) assets are positioned at stock points, such as Naval Supply Centers and Supply Depots, under the operating control of NAVSUP. The initial source of all 2Z cog material is from procurement using OPNAV furnished investment appropriation funds, or funds provided by another service, or a foreign government. These funds are authorized only for the procurement of a specified quantity of a specific electronic system or equipment.

Subsequent to initial procurement, assets in inventory can accumulate as the result of a reduction in end user installations (e.g., a cut-back in the number of new ship constructions after the 2Z equipment has been acquired), ship or shore station inactivations resulting in the return of installed 2Z cog equipment to inventory, and/or replacement of a 2Z cog item with a more advanced piece of equipment through ship modernization programs or equipment redesign. The 2Z cog items which fail and are forwarded to a designated overhaul point (DOP) and are subsequently repaired will, upon repair, be included in the 2Z cog RFI inventory. However, if the end-user requires a replacement in kind, the net asset position will be unchanged. Consequently, receipt of RFI items from restoration/repair cannot be considered a normal source of increases in inventory assets.

The propensity of electronic equipment to fail in part has been recognized and restoration/repair programs have been in effect Navy-wide for many years. NAVELEX's depot level repair program is designed to induct not-ready-for-issue (NRFI) 2Z cog carcasses into a designated repair depot, and upon completion of repair, place the RFI unit in inventory to meet subsequent planned or unplanned requirements. The repair parts, consumable supplies, and labor required to repair a system or related equipment are charged against NAVELEX O&MN funds.

The depot level repairable program O&MN funds are allotted to NAVELEX by OPNAV via NAVMAT. The projection of repair funding requirements by NAVELEX for 2Z cog items is accomplished by manually reviewing the historical rate of receipt of NRFI carcasses from end-users on a quarterly basis, applying the historical repair turn-around time (the elapsed time from the time of induction of an NRFI carcass at a DOP to the time repairs are completed), applying the historical survival rate (that percentage of NRFI carcasses which can be repaired), and manually estimating the number of planned and unplanned requirements which will be received for each 2Z cog item.

B. ATTRITION OF 2Z ITEMS

The survival rate quantifies the percentage of NRFI carcasses which historically have been capable of being resurrected in the repair process. The percentage of NRFI carcasses that are not repairable attrite from the Navy's asset base for the particular 2Z cog items involved. Current funding

requests and authorizations do not provide for replacement of attrited material that is managed by NAVELEX.

OPNAV does permit spare equipments to be procured on a restricted basis in conjunction with a new installation procurement. Specifically, spare systems or units thereof, shall be included as a programmed requirement only if both of the following criteria apply (1):

(1) The provisioning process has not provided all items necessary for the assembly of a complete installation;

(2) Non-availability of a spare system for replacement will seriously degrade the capability of a combatant unit to carry out the missions for which it was designed. Procurement of spare equipments is limited to one spare if fifty or less installations are planned, or to two spare equipments if more than fifty installations are planned.

This OPNAV policy was designed to provide replacement of a system lost due to major damage, such as fire, collision, storm, or battle damage. It was not designed to provide replacements for repair attritions.

NAVSEA has apparently attempted to extend this policy to provide additional supply levels to meet demand requirements. In NAVSEAINST 4410.1 a procedure has been established whereby supply levels for major shipboard equipments managed by NAVSEA are calculated on the basis of predicted demand. These requirements are then included in NAVSEA's budget request for procurement funds. (11) Whether this procedure has been effectively employed or not, the intent is clearly to expand the basic purpose of the OPNAV policy.

In the absence of a procedure similar to NAVSEA's, NAVELEX is confronted with a potential inability to satisfy requests for those 2Z cog items which experience an attrition of assets through the repair program.

C. REQUIREMENTS/DEMANDS FOR 2Z COG MATERIAL

Demands for NAVELEX managed material can be classified into two major categories: planned, and unplanned. (The terms programmed and unprogrammed are also used.) Planned requirements are those generated by an approved Navy program to install new electronic equipment at a shore station or aboard fleet units. NAVELEX is provided with planning information as to the specific equipment required, quantities required, and the delivery schedule.

Planned requirements have three principal sources: Basic Electronic Shore Equipment Plan (BESEP) requirements, Ships Program Directive (SPD) requirements, and Fleet Modernization Program (FMP) requirements. BESEPs represent planned requirements for shore-based activities, and are normally a result of the establishment of a new shore station or a program to update currently installed shore electronic equipments. (4:83)

SPDs are prepared for new ship construction by NAVSEA. An SPD is a detailed description of requirements for a specific ship acquisition program.

FMP requirements are formulated by NAVSEA to support ship modernization efforts. Specific hardware requirements are incorporated into the Ship Alteration Management Information System (SAMIS). NAVELEX receives a SAMIS report which serves

as the source document for FMP requirements.

The BESEP, SPD, and FMP related requirements are all characterized by advance requirements planning. In addition, funding to procure additional and/or new electronic equipment is programmed in advance within a specified procurement appropriation.

Unplanned requirements are of three basic types: Military Interdepartmental Purchase Requests (MIPR), Foreign Military Sales (FMS), and Navy. (4:84) MIPRs are requests from other U.S. military services, or federal agencies, for NAVELEX managed equipment. MIPRs are received with no advance planning inputs and are processed by NAVELEX as any other current unplanned requisition would be. MIPRs include funding documentation and are consequently classified as funded, unplanned requirements.

Foreign Military Sales requirements are received from foreign governments via the Navy International Logistics Control Office (NAVILCO), Bayonne, New Jersey. NAVILCO provides funded requisition documents to NAVELEX, therefore FMS requirements are also funded, unplanned requirements.

Unplanned requirements received by NAVELEX from Navy activities present the greatest potential difficulty since they are unfunded. Operating expenses of all Navy ships and most shore stations are funded from the O&MN appropriation. Operating funds are provided for the purpose of requisitioning and/or purchasing expense type material. However, investment type material, such as 2Z cog items, are provided on a

no-cost basis to Navy operating forces. Consequently, when a Navy ship or shore station requires a replacement for a failed 2Z cog item it submits an unfunded requisition into the supply system.

All 2Z cog items are assigned a material control code identifying them as repairable. Material control codes applicable to repairable equipment are explained in greater detail in Appendix C. It is mandatory for end-users to turn failed repairable equipment into the nearest stock point for further shipment to a designated overhaul point (DOP).

Requisitions from end-users for designated repairable material must include an advice code indicating that the failed unit/equipment has been turned in or will be turned in upon receipt of the replacement equipment, or that the equipment is missing or damaged beyond repair and no turn-in will be made. The requirement may also be the result of an increase in equipment allowance and no failed unit will be turned in. Advice codes 5G, 5S, 5A, 5D, or 5V apply to all mandatory turn-in items. (13) Appendix D provides a more complete explanation of each advice code and its use.

D. SATISFYING DEMANDS FOR 2Z COG MATERIAL

A requisition with a valid advice code of 5D or 5V is a demand for a planned requirement. Since equipment has been procured in advance of the scheduled required delivery date, this type of demand normally poses no difficulties for NAVELEX.

Unfunded, unplanned requirements (UUR), with advice codes 5G, 5S, or 5A assigned to the requisition, are requests for replacement of failed equipment which normally affects the operating capability of the requisitioning activity. There is usually a sense of urgency in satisfying these requirements. Historically NAVELEX has satisfied UURs from the following sources (4:86):

(1) Assets on hand in a NAVELEX controlled inventory.

(2) Assets obtained through repair of NRFI carcasses held at a DOP but not yet repaired at the time the UUR is received.

(3) Assets recovered/removed from ships and shore stations designated for striking (removal from service) or closure, respectively.

(4) Assets cannibalized from reserve ships.

On-hand assets can be composed of three major categories of material (4:86):

(1) Equipment acquired for planned requirements which has been received from the contractor and is being held in inventory until the scheduled requirement date.

(2) RFI assets obtained from a DOP upon completion of the repair of NRFI carcasses in anticipation of future demand.

(3) Equipment originally purchased to meet a planned requirement which was subsequently reduced in quantity or canceled.

Use of inventory assets, reserved to meet upcoming planned requirements, to satisfy a UUR requires the approval of the appropriate NAVELEX Acquisition Manager and/or OPNAV Resource

Sponsor. This approval is required because the release of a planned requirement asset could jeopardize the program/ project concerned. In most cases, where the requisitioner is an operational unit and a casualty report (CASREPT) has been issued, authority to utilize a planned requirement asset is given on the basis that the operational requirement is more urgent.

A UUR can be satisfied in a timely manner only in those instances when assets are in inventory. In the absence of on-hand inventory, the decision to repair a NRFI carcass held by a DOP means a delay in satisfying the UUR equal to the time required to repair the NRFI unit. Eliminating this delay is dependent upon reliable forecasting of UURs for each 2Z cog item and adequate funding of the depot level repair program. These factors were addressed by the Hanson thesis (2) and will not be dealt with here.

It is important to note that NAVELEX cannot satisfy UURs by procuring replacement equipment, either in advance in anticipation of a UUR (pipeline), or at the time a UUR is received. This is true because NAVELEX is funded only for procurement of new installation equipment and not for replacement of failed equipment.

E. DEMAND ANALYSIS

Analyses of demand for 2Z cog material have been performed by McCarthy, et al. (4), Pettersen and Casey (15), and Seebeck (16) for different periods of time from 1972 through 1977. In each analysis, demands were identified as being a planned pro-

gram requirement (PPR) or an unplanned requirement. Further distinctions were made between funded and unfunded unplanned requirements.

Manual analysis of 396 items, done by McCarthy, et al, showed that 28.8 percent of average quarterly demands (requisitions received) were for unplanned requirements. UURs made up 97.9 percent of the average quarterly unplanned requirements. (4:47) Pettersen and Casey were able to analyze all transactions for 2Z cog material from 1975 to 1977 inclusive. They found that, of approximately 1,900 line items managed by NAVELEX, only 960 received any demands. Two hundred sixty-four line items received PPR demands, and 772 received unplanned requirement (UR) demands. Apparently, 76 items received both PPR and UR demands. (15)

Seebeck (16) purified the Pettersen and Casey analysis to account for some minor errors in transaction classification. His analysis of transactions for 1,667 line items resulted in the following statistics; 976 line items received no demands, 691 line items received at least one demand, 180 line items received only PPR demands, 436 line items received only UR demands, and 75 items received both PPR and UR demands.

As stated previously, the survival rate of NRFI carcasses has a potential impact on the asset base since the inverse of survival is attrition. McCarthy, et al, (4) performed an analysis of inventory characteristics for all 2Z cog items on the inventory technical data file maintained at SPCC. (This file is titled the Master Data File (MDF) and contains all

transactions for current 2Z cog items.) This analysis identified the average survival rate for 2Z cog material as 0.85. However, further analysis indicated that a 0.85 survival rate was recorded as a system standard, or constant, for a significant number of items. Computation of average survival rates for only those items with a survival rate other than 0.85 resulted in an average survival rate of 0.90.

A review of survival rates for 26 2Z cog items related to the AN/WRC-1 Family Radio, conducted in April 1979, resulted in an average survival rate of 0.95, with a range from 1.0 to 0.82. The survival rate data for the 26 items is presented in Appendix E. The 26 items were selected as an adjunct to a review of the AN/WRC-1 Family Radio demand data and were not randomly selected. Therefore, these survival rates are not statistically representative of all 2Z cog items. Nonetheless, the results tend to support the premise that actual survival rates for 2Z cog material are higher than 0.85.

The MDF survival rates for 2Z cog items can be updated by SPCC on the basis of inputs from NAVELEX Inventory Managers. Discussions with NAVELEX Inventory Managers indicated that they do not submit actual survival rate data to SPCC. As a result the MDF is not updated to reflect current survival rates. However, current survival rate data are maintained manually within NAVELEX. The perception of NAVELEX's Inventory Managers (IM) is that the data on the MDF for 2Z cog material are only for NAVELEX's benefit and the effort

required to update the MDF file is not justified since the data are available in-house. Consequently, the potential funding impact of NRFI carcass attrition cannot be accurately determined from the MDF data.

F. STOCK COORDINATION

NAVMAT has prepared a draft instruction concerning stock coordination which will, as currently worded, limit HSCs' management to the following criteria (9):

(1) Items in a research and development stage. Items qualifying under this criterion must be in the process of development and must be funded with Research and Development dollars. Just because an end item, component, or assembly is in test and evaluation does not justify the exclusion of its intrinsic parts from stock coordination review.

(2) Items requiring engineering control decisions. This criterion is applicable when a high degree of engineering judgement is required concerning design or relationships to a system. It pertains principally to items requiring engineering design or relationship decisions during the full-scale development phase of a new system acquisition, until the successful completion of the First Article Technical and Operational tests. The primary purpose of the full-scale development effort is to ensure completion of sufficient engineering and logistics efforts to permit a confident commitment of resources required for production. The milestones of Approval for Service Use (ASU) or production approval given by the Office of the Secretary of Defense (OSD) signifies

minimal risk and stability of design of the system/equipment, and indicates prime candidates for transfer from an HSC to an ICP. Configuration control complexities will not justify retention of the inventory management function by the HSCs.

The revised NAVMAT criteria for HSCs to manage items does not provide for design instability. The possible impact of this new policy is addressed in the Discussion section of this thesis.

The requirement to transfer inventory management to SPCC in compliance with the Stock Coordination Program criteria raises the issue of SPCC's ability to manage NAVELEX-interest material. Included within this issue is the reliability of SPCC's requirements forecasting system vis-a-vis NAVELEX's requirements forecasting system.

G. DETERMINATION OF REPAIR AND PROCUREMENT QUANTITIES

NAVELEX primarily uses a manual process for determining 2Z cog item repair quantities. NAVELEX IMs manually prepare a Restoration Calculation Worksheet for each 2Z cog item to determine how many NRFI units must be inducted into the restoration program and how many units must be procured. The Restoration Calculation Worksheet is designed to take the following factors into consideration:

(1) Planned requirements for approved Navy programs to be delivered in the fiscal year concerned.

(2) Projected annual quantity of UURs, based on average historical quarterly demand.

(3) Quantity of RFI units in inventory.

(4) Quantity of NRFI units in inventory at a DOP awaiting induction for repair.

(5) Projected quantity of NRFI carcasses to be turned in by end-users, based on historical averages.

(6) Average repair turn-around time (RTAT).

(7) Average survival rate.

Manual calculations resolve these factors into anticipated inventory assets. Under existing policy, the number of new units to be procured can equal, but cannot exceed, the planned requirement quantity. However, the assets available through the depot level repair program can reduce the number of new units to be procured if forecasted UUR demand is less than the number of NRFI units that can be repaired in the fiscal year concerned. Based upon projected inventory requirements the procurement and restoration funding requirements are calculated for applicable budget and POM exhibits.

Discussions with NAVELEX IMs and supervisory personnel indicated that forecasts of NRFI carcasses to be turned in are no longer included in the above calculation. This omission would tend to understate the NRFI carcasses available for restoration. Therefore, a lower dollar requirement for O&MN funds to conduct the restoration program will result.

In contrast to NAVELEX's relatively simple, unsophisticated repair requirements forecasting system, SPCC uses a highly computerized inventory modeling system. Demand forecasting is accomplished using the Uniform Inventory Control Point (UICP) computer programs. These programs utilize

advanced inventory modeling techniques, capable of calculating inventory levels required to satisfy projected demands at a given level of effectiveness. That is, if the objective is to satisfy 85 percent of demands received from on-hand inventory, the UICP program is designed to calculate the inventory level required to meet that objective.

The calculation of inventory requirements, funds required to buy replacement units, and funds required to repair failed repairable units is accomplished by the Stratification (STRAT) segment of the UICP system. The STRAT program compares forecasted demands with assets on hand and/or available from the depot level repair program, identifies shortfalls as procurement requirements, and arrives at an estimated cost to effect restorations and to buy replacement/shortfall assets. Factors such as RTAT, mean time between failure (MTBF), procurement leadtimes (PLT), and survival rates (SR) are used by the STRAT program to arrive at the restoration and procurement costs. (3)

The inclusion of the SR factor for each item results in NRFI carcass attrition from the repair program being included in the calculation of equipment replacement requirements.

H. SYSTEM MATERIAL AVAILABILITY

The effectiveness of SPCC's and NAVELEX's inventory management procedures and funding levels can be assessed to some extent by reviewing the System Material Availability (SMA) attained for various cog material. SMA measures the percentage of requisitions which are satisfied by the Naval Supply System at the time a requisition is received for

items for which the system maintains stock. While the stock point initially receiving the demand may not have the required material in inventory, if the cognizant inventory manager, either at an ICP or an HSC, can refer the requisition to another stock point which does have the material requested, the demand is considered to have been satisfied for SMA calculation purposes.

SMA data for 4G and 2Z cog items (as well as other hardware related cogs) from fiscal year 1976 through February 1979 are shown in Appendix F. Direct comparison can be made between 2Z and 4G cog material only for fiscal year (FY) 1976 to the present because SMA data for 2Z cog material was not available prior to FY 76.

The general trend for 2Z cog material has been downward, dropping from 88.5 percent in FY 76 to 79.1 percent for FY 78. The results for the first quarter of FY 79 show an SMA of 71.6 percent, signalling a further decline in 2Z cog SMA.

Conversely, the SMA trend for 4G cog material has been upward, increasing from 61.7 percent in FY 76 to 71.0 percent in FY 78. Results for the first quarter of FY 79 show a decline to 68.5 percent but it is too early to conclude that a reversal of the previous years' increases will occur in FY 79, especially since February's SMA is 71.7 percent.

To put both NAVELEX and SPCC SMA figures in perspective, the CNO objective is 85 percent. By the CNO standard neither NAVELEX nor SPCC are doing well, but a review of all other Navy cogs shown in Appendix F indicates that only a few have

been able to achieve CNO's standard. The SMAs for 8H, 6A, 6H, and 6X cog material (Polaris Poseidon submarine program support material) are obvious exceptions, with SMAs that have consistently averaged in excess of 85 percent.

The other obvious exceptions are the SMAs for the NAVSEA cog material (i.e., 2F, 2J, and 2S cogs) which have consistently averaged near 90 percent. Of particular interest is the average SMA of approximately 90 percent for 2F cog material which is the cog for major shipboard electronic equipment.

V. DISCUSSION

A. 2Z COG MATERIAL ASSET DEPLETION

There are two basic causes for 2Z cog material assets, Navy-wide, to be depleted; attrition from the depot level repair program and total/major damage at the end-user level. Present OPNAV policy for funding spare equipments is designed to provide replacements for losses due to total/major damage.

The adequacy of the quantity of spare equipments allowed by the present OPNAV policy has not been evaluated by NAVELEX. Since requisitions citing advice code 5A indicate an asset loss caused by major damge, a review of 2Z cog transactions recorded on SPCC's MDF would provide the information needed to evaluate the OPNAV policy.[2]

B. 2Z COG MATERIAL REPAIR ATTRITIONS

The losses due to attrition from the depot level repair program are potentially more serious than losses due to major damage since attrition is a continuous process as long as NRFI units are being input into the restoration program. The severity of the attrition problem is a function of the following factors:

(1) The average attrition rate for each 2Z cog item.

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[1]The demand analyses done by McCarthy, et al, (4), Pettersen and Casey (15), and Seebeck (16) did not stratify UURs by requisition advice code. Consequently, their collective analyses could not be used to assess the adequacy of the OPNAV policy for funding procurement of spare equipments.

(2) The percentage of end use equipment installations of each 2Z cog item that fall in any given time period due to inherent equipment reliability.

(3) The number of end-use installations for each 2Z cog item.

The repair and subsequent attrition of carcasses is an iterative process which depletes the Navy's total number of units for each repairable item. Unless the number of end-use equipment installations declines concomitantly, the depletion of assets will result in a shortage of units to meet end-use requirements. However, there is presently no specific policy authorizing procurement of replacements for losses due to attrition of 2Z cog items with ICPs. The CNO's definition of principal and secondary items established that mutually exclusive relationship. In conjunction with the other characteristics attributed to principal items by CNO's definition, the ability of HSCs to obtain funds to replace attrited units has been impaired.

C. DISTINGUISHING BETWEEN PRINCIPAL AND SECONDARY ITEMS

The CNO's association of principal items with HSC inventory management and secondary items with ICP inventory management creates a problem whenever the items managed by an HSC do not conform to all of the other characteristics ascribed to principal items by the CNO. Namely, principal items experience planned requirements only and fail in total only due to major/total destruction. Secondary items, on the other hand, experience random, unplanned demand and fail through

normal in-service use. To the extent that 2Z cog material experiences UUR demands, NAVELEX manages items which are, by definition, secondary items.

Pettersen's and Casey's analysis of 2Z cog demand data, presented in the Analysis section above, indicated that, approximately 80 percent of the items managed by NAVELEX which experienced any demand, experienced unplanned requirement demands. Seebeck's analysis also presented in the Analysis section above, indicated that 74 percent of the items managed by NAVELEX which experienced any demand, experienced unplanned requirement demands.

The recognition that 2Z cog items experience UR demands requires concomitant acceptance that NAVELEX manages both principal and secondary items.

Newly developed electronic systems and related equipment may be assigned a 2Z cog during the early phases of their life cycle (e.g., production and installation) and possess all the characteristics to be properly classified as principal items. However, subsequent demands generated by an equipment's failure in-part under operating conditions can result in the equipment being technically reclassified as a secondary item.

Based on the CNO's definition of principal and secondary items, the argument that 2Z cog material exhibiting secondary item traits should be transferred to an ICP appears reasonable. Such a transfer of inventory management responsibility would be in conformance with the Stock Coordination Program's policy and objectives.

D. STOCK COORDINATION

The current NAVMAT criteria for an HSC to retain inventory management responsibility for an item emphasizes design stability and technical/engineering control requirements. The absence of a generally accepted definition of design stability has allowed NAVELEX Acquisition Managers to exercise a great amount of judgement when applying the design stability criterion.

As a result, NAVELEX has retained inventory management of items which are, by demand criteria, secondary items. Demand data for AN/WRC-1 Family Radio 2Z cog items, shown in Appendix G, provide a good example of 2Z cog items that have experienced a relatively high volume of UURs. Yet, as the copy of a NAVELEX internal memorandum shown in Appendix H states, AN/WRC-1 related items are considered to be design unstable for the reasons given in the memorandum. Consequently, NAVELEX has retained inventory management of these items.

By permitting NAVELEX (or any other HSC) to retain inventory management of items exhibiting secondary item demand characteristics, the NAVMAT Stock Coordination review criteria have created inventory management responsibilities that are contrary to the CNO's definition of principal and secondary items.

The drafted revision to NAVMAT's Stock Coordination Program instruction would effectively eliminate design instability as justification for an item to be retained by an HSC. Issuance of the revised instruction, as currently written, could result in all but newly developed systems and related

equipment being transferred to an ICP for inventory management.

Additionally, the revised instruction's reliance on Approval for Service Use as an indication of design stability may prove to be invalid in the long run. Design changes to electronic equipment, to improve or modify performance and/or reliability, are not uncommon with the rapid technological advancements that occur in the electronics industry.

Engineering or design changes, made subsequent to the pilot production-run, which are not significant enough to warrant the assignment of a different national stock number (NSN) to the equipment, would make the pilot production item a less preferred design. Such changes are termed Class II changes.[3] An inventory manager must be cognizant of such situations so that a subsequent procurement will be for the modified equipment design and not the original equipment design.

One of the reasons design stability has been important to the Stock Coordination Program is the incompatibility of the individualized attention normally considered necessary to properly manage an item which is design unstable with SPCC's highly automated inventory management system. SPCC's inventory management system has been designed to efficiently manage a large quantity of items which receive random demands, can

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[3]A Class I change alters the form, fit or function of an equipment, and requires that a new NSN be assigned. The equipment must also be reprovisioned.

be routinely reprocured to replenish inventory levels, and can be issued from inventory with minimal manual processing of the applicable transaction. An item that is design unstable usually cannot be reprocured or issued to end-use without manual intervention.

The design specifications must be verified for a design unstable item prior to initiating reprocurement to ensure that the specifications incorporate the latest preferred components. Similarly, the design characteristics of an item in inventory should be verified prior to issue to end-use to determine whether or not it contains the latest preferred components. If it does not, it may not be suitable for issue to specific end-users.

SPCC's manpower resources have been established at a level consistent with an automated, sophisticated inventory management system. The difference between NAVELEX and SPCC manning of the inventory management function is evident in the average number of line items assigned to an inventory manager (IM). A NAVELEX IM currently has an average of 80 to 100 line items to manage. An SPCC IM is responsible for an average of about 3,000 line items. (16:46)

The fewer line items managed by a NAVELEX IM makes it much more likely that equipment peculiarities, design changes, and reprocurement restrictions will be observed in inventory management decisions.

The motivation for continued pressure on NAVELEX to transfer inventory management of material to SPCC is apparently

based in part on the perception that SPCC's inventory management system provides better support for items managed.

E. INVENTORY MANAGEMENT EFFECTIVENESS

SPCC's use of the UICP program for determining order and repair quantities and the STRAT program to determine funding requirements has achieved a relatively high level of credibility and acceptance at the NAVMAT and OPNAV level. Consequently, SPCC has been relatively successful in defending its budget and POM submissions. (2)

By comparison, NAVELEX's relatively simple method of determining repair quantities and its funding requirements projection method are not as readily accepted by budget reviewers, both internal and external to NAVELEX.

As an indication of the resulting inventory management effectiveness achieved by NAVELEX and SPCC with their different inventory management systems, a review of SMA data was presented in the Analysis section of this thesis. By comparison of SMAs, NAVELEX appears to be more effective than SPCC.

One reason for NAVELEX's higher SMA figures, despite the absence of funds to replace attrited units, could be that a higher percentage of its inventory experiences planned requirement demands. Inventory items which have only planned requirements should achieve a 100 percent SMA. The demand is expected to occur and an asset has been placed in inventory to meet the demand.

Therefore, the ratio of inventory items receiving primarily planned requirement demands to inventory items receiving primarily unplanned requirement demands must be known for both NAVELEX and SPCC. Without this information an accurate assessment of the significance of the respective SMA figures cannot be made.

The required ratio can be calculated for NAVELEX from the demand data analysis done by Pettersen and Casey, and by Seebeck (presented in the Analysis section of this thesis). Using Pettersen's and Casey's data, 2.9 times as many inventory items received unplanned requirement demands as received planned requirement demands. Seebeck's data results in a ratio of 2.0. Unfortunately, the data required to calculate this ratio for 4G cog material was not readily available for use in this thesis.

F. AN ALTERNATIVE AND/OR CONCURRENT APPROACH

Transferring material to NAVSUP ICPs for inventory management may or may not result in more effective support or efficient inventory management. Further analysis is required before the issue can be resolved. However, an alternative means of improving support effectiveness may be for NAVELEX to obtain funds to replace asset attritions.

To support the requirement for procurement funds to obtain replacement equipment NAVELEX must first determine the magnitude, in terms of equipment quantities and dollars, of the replacement requirements. The equipment losses due to major damage are documented by requisitions with 5A advice

codes and NAVELEX can obtain this data from the MDF, or its own cumulative end item ledger (CENILE) tapes. This data can be used to calculate the restoration program attritions for each 2Z cog item.

Discussions with OPNAV personnel indicated that a request for funds to replace attrited units was justifiable and could be approved if adequate, credible supporting data was provided. Such a request should be included as a POM requirement for each applicable equipment line item of the OPN exhibit.

There is no assurance that such a request would actually be approved by OPNAV, or, if approved by OPNAV, that it would be approved by higher authority. But, until such requirements are given POM and budget visibility, NAVELEX has no chance of being able to replace attritions.

VI. CONCLUSIONS

NAVELEX has not requested funding to procure replacement units for 2Z cog material attritions. The apparent rationale for this policy has been that, in accordance with CNO's definitions of principal and secondary items, the HSCs only manage principal items which, by definition, do not fail or require replacement except in cases of major catastrophe.

Analysis of demand data clearly indicates that NAVELEX manages items which experience random demand characteristics of a secondary item. It is presumed that an overwhelming majority of these UUR demands are generated in conjunction with the depot level repair program. In this regard, these 2Z cog items are virtually identical to the special class of secondary items known as spares. Therefore, for the most part, these demands do not require one-for-one procurement to satisfy them.

Rather than support NAVELEX's management of items receiving UURs, both OPNAV and NAVMAT have taken the position that such items should be managed by SPCC. The Stock Coordination Program has been the vehicle used to compel NAVELEX to transfer items to SPCC for inventory management. However, the exceptions granted for items with design instability and items requiring technical/engineering control decisions have allowed NAVELEX to maintain inventory management responsibility for numerous secondary items.

Implementation of the proposed NAVMAT changes in criteria for retention of inventory management at an HSC would eliminate the criteria of design instability and engineering/technical control complexities, and would result in the transfer of essentially all secondary type items to an ICP. Such a development would be in strict accordance with Navy inventory management policy to make NAVSUP ICPs the inventory managers of as many Navy items as possible. This policy is apparently based, in part, on the expectation that greater efficiency and better effectiveness will result. To the extent that items transferred to an ICP are design unstable or require engineering decisions to maintain configuration integrity, improved efficiency and effectiveness will probably not be achieved. Any item requiring manual processing, and/or individual attention and control, is contrary to the highly automated inventory management procedures employed at an ICP.

Manual processing at an ICP or at an HSC would appear to require equal resources and effort. Consequently, other factors, such as interpersonal communications, coordination of technical and inventory requirements, protection from erosion of inventory management efforts to other tasks, and geographic convenience would have to be considered. In this respect, a valid argument may be made for inventory managers to be organizationally co-located with the acquisition managers and acquisition engineers at the HSC.

The nearly equivalent SMA performance of SPCC and NAVELEX for 4G and 2Z cogs, respectively, superficially indicates

there is no significant advantage to placing inventory management for electronic communication equipment at SPCC, as opposed to NAVELEX. However, as noted in the Discussion section above, additional research is required to prove or disprove this observation.

The repairable feature of both 2Z and 4G cog items permits a depot level repair program to be the primary means of satisfying end-user unplanned demands. Consequently, it seems logical that the SMA achieved for 2Z and 4G UUR demands would be primarily a function of the funding provided for the respective repair programs. Although Hanson (2) determined that NAVELEX's restoration program has been essentially level funded in recent years, a comparative study of SPCC's funding level for its depot level repairable program is required before any conclusion can be drawn about the impact of funding on SMA results.

As long as NAVELEX continues to manage secondary type items, an effort must be made to obtain funding to procure replacements for equipment which attrites from the inventory base. NRFI carcasses which are not recoverable through the restoration process, and equipment which is lost or destroyed in use, cause a reduction in the Navy's total asset position of the equipment involved.

VII. RECOMMENDATIONS

In the preceding sections an effort has been made to identify the problems and the principal factors affecting NAVELEX's ability to manage 2Z cog items. While emphasis was placed on financial implications, other factors discussed, such as determination of design stability, methods for determining repair requirements, and inventory management procedures, must not be overlooked in determining which activity/command should manage present 2Z cog material.

The following action is recommended on the basis of the information and concepts discussed in the preceding sections:

(1) NAVELEX should determine if 5A advice coded requirements exceed the spare equipment procurement quantity authorized by OPNAV. A review of 5A advice coded requisitions for each 2Z cog item is required to provide the data necessary to evaluate the adequacy of this OPNAV policy. To the extent these requirements exceed the authorized quantity of spare equipments, additional funding should be requested.

(2) NAVELEX should prepare written justification for the procurement of equipments to replace attrited units and calculate the OPN funds required to do so. The replacement funds required and the supporting justification should be included in the OPN requirements submitted for the next POM process. To substantiate the funds to be requested NAVELEX must determine the actual repair attrition for each 2Z cog item. The funds requested should be limited to what is

required to maintain total equipment assets at the level needed to support the number of authorized installations. Specifically, procurements to establish a pipeline of inventory assets to cover repair turn-around time is compatible with the concept of repairable electronic systems and related equipment. Sources of assets currently used by NAVELEX to satisfy UURs may, or may not, continue to provide enough assets to meet this pipeline requirement. In those instances where these sources can no longer be relied upon, currently authorized spare equipment procurements must be used to provide insurance/pipeline stock.

(3) The depot level repair program must continue to be the primary source for meeting random demands. The recommendations made by Hanson (2) to seek improved funding of the depot level repair program apply.

(4) NAVMAT and OPNAV should accept that there are legitimate technical control and design stability reasons why NAVELEX should manage secondary type items. The current NAVMAT criteria for retention of items by the HSCs, in fact, provides for these cases; however, the proposed changes to the criteria do not. Therefore, NAVMAT should retain the current retention criteria. OPNAV should be willing to support a NAVELEX request for OPN funds to replace attrited equipment. The CNO definition of principal and secondary items should not be a basis for non-funding of these requirements. In fact, the CNO definition should be amended to the effect that both principal and secondary items may be managed by either an HSC or an ICP.

(5) NAVELEX should continue to support the present Stock Coordination Program. NAVELEX managed items should be maintained at the minimum number consistent with technical control and design stability considerations. Strict adherence to the present NAVMAT retention criteria should be observed to maintain the integrity of the need for NAVELEX to manage material.

APPENDIX A

NAVELEX Directorates

A simplified view of NAVELEX's organizational structure is shown in Figure A-1. The basic responsibilities of each of the major directorates are described in the following paragraphs.

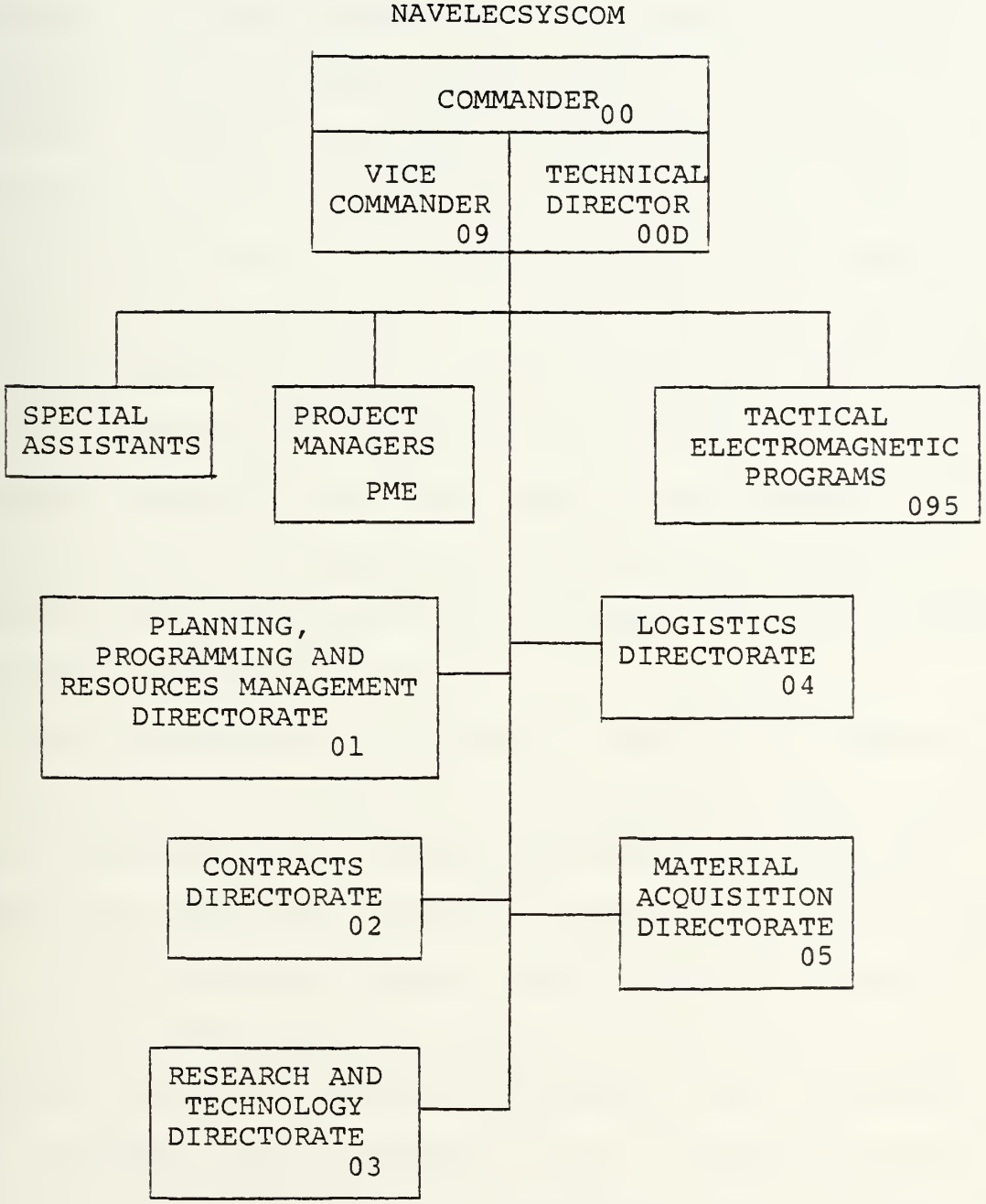
The Planning, Programming and Resource Management Directorate (ELEX 01) is responsible for financial management and control, budgeting, and manpower ceiling allocations. The budgeting function includes projection of funding requirements to satisfy inventory management acquisitions and restorations. These projections are submitted via NAVMAT to OPNAV for inclusion in the Program Objectives Memorandum (POM) process.

The Contracts Directorate (ELEX 02) is responsible for accomplishing NAVELEX's contractural obligations in conformance with current law and regulations. ELEX 02 develops and promulgates Command policies for contract award and administration, participates in advance procurement planning, prescribes appropriate procurement methods to be used for a specific acquisition, and awards contracts. (4:70)

The Research and Technology Directorate (ELEX 03) is responsible for administering NAVELEX Research, Development, Testing and Evaluation (RDT&E) programs, planning and executing NAVELEX programs for research, exploratory and advanced development, and laboratory support, and identifying and acquiring specific scientific and technical data to support

Figure A-1

NAVELEX ORGANIZATION



weapons systems, research, development, engineering and testing. (4:70)

The Logistics Directorate (ELEX 04) is responsible for providing logistics support to systems and equipment being developed to satisfy operational requirements. It develops Integrated Logistic Support Plans (ILSP) for NAVELEX-interest electronic system and equipment acquisitions, including engineering change or retrofit program acquisitions. ELEX 04 also liaisons with ASO and SPCC regarding supply support for equipment for which NAVELEX is assigned technical responsibility.

The Material Acquisition Directorate (ELEX 05) is responsible for managing the acquisition of electronic systems and equipment assigned to NAVELEX. ELEX 05 is composed of several Divisions which have specific responsibilities pertaining to managing electronic systems and equipment. The most relevant Divisions are described below.

The Telecommunications Division (ELEX 510) is responsible for the design and discipline of telecommunications systems. ELEX 510 personnel are normally designated as Acquisition Managers for applicable electronic systems and related equipment. The Acquisition Manager function includes responsibility for design, development, and acquisition of a system and/or equipment and for the design, development, and acquisition of the integrated logistic support. (6:49) Coordination with the ICPs is required for those electronic items for which the ICP has inventory management responsibility but technical responsibility remains with NAVELEX.

The Air Traffic Control, Surveillance and Navigation Division (ELEX 520), the Command and Control Division (ELEX 530), the Marine Corps and Amphibious Division (ELEX 540), and the Security Engineering Division (ELEX 550) all perform basically the same functions as does ELEX 510, limited to equipment types applicable to each Division.

The Production Division (ELEX 504) performs inventory management functions for the major electronic equipments assigned to NAVELEX for material support. The Communications Material Management Branch (ELEX 5048) and the Radar-EW-Support Material Branch (ELEX 5049) are responsible for inventory control of assigned electronic material. Inventory control encompasses receipt, identification, issue, restoration, stratification, stock coordination, item management review, disposal, and financial inventory accounting and reporting. ELEX 5048 and 5049 also conduct periodic requirement reviews to determine maintenance replacement levels, projected restora- requirements, and adequacy of procurement plans and disposal plans. Coordination with the ICPs is required to successfully implement stock transfers and maintain stock data files.

APPENDIX B

Electronic Equipment Inventory Management Assignments

The cognizance symbols shown below cover the majority of electronic systems and related equipment. The material description provided for each cognizance symbol has been abbreviated to include only electronic equipment and does not include other equipments covered by each cognizance symbol. Electronic equipment cognizance symbols related to special systems, such as Polaris/Poseidon/Trident submarines, have not been included. (12)

Cognizance Symbol	Inventory Manager	Description of Material
1H	SPCC	Navy Stock Fund material assigned to SPCC for inventory management. Includes electronics items which are required in support of the electronic equipments assigned to ASO or SPCC for program support.
2F	NAVSEA	Major shipboard electronic equipment. Consists of equipments, components, and supporting items in support of new construction or conversion, fleet modernization (FMP), and fleet maintenance. Includes: 1. All shipboard radar equipment and Naval Tactical Data Systems (NTDS); 2. All submarine

Cognizance Symbol	Inventory Manager	Description of Material
		communication antenna systems and subsystems; 3. All Navy sonar equipment, including underwater swimmers communications equipment.
2H	SPCC	Shipboard electronic (repairable or investment type material) and base equipment, assemblies, components and repair parts. Includes items required for the support of general hull, mechanical, and electrical equipment.
2R	ASO	Aeronautical, photographic, and meteorological material (repairable or investment type material). Includes peculiar parts, components, or assemblies required to support: 1. Installed aircraft instruments designed for computing, directing, controlling, detecting, or measuring as it concerns navigation safety, flight, or aircraft operation (includes automatic pilot and gyro equipment); 2. Airborne communication and navigation equipment, such as radio, radar, avionics, aircraft intercommunication systems airborne sonar

Cognizance Symbol	Inventory Manager	Description of Material
		devices, and sound recording and reproducing equipment; 3. Guidance and launching equipment for airborne missiles; 4. Test equipments and test sets required for testing airborne aircraft accessories, aircraft propulsion engines, and avionics equipment.
2Z	NAVELEX	Shore (ground) and shipboard electronic equipment. Includes: 1. Shore (ground) electronic equipment; 2. Shipboard electronic equipment (to include communications, identification friend or foe (IFF), electronic warfare (EW), and radio navigation); 3. Fixed underwater surveillance systems; 4. Electronic navigation; 5. Landing aids and traffic control aids; 6. Space surveillance systems; 7. Shorebased strategic data systems; 8. Operational control center; 9. Communications data-link systems; 10. Radiac equipment; 11. Tritium air monitors; 12. Special electromagnetic communications for Fleet Ballistic Missile System; 13. Standardized telemetry equipment and components; 14. Cryptographic

Cognizance Symbol	Inventory Manager	Description of Material
		equipment; 15. General purpose electronic test equipment (GPETE) and common components; 16. Marine Corps expeditionary and amphibious electronic equipment; 17. Meterological electronic equipment; 18. Multi-platform electronic systems; 19. Intelligence processing equipment; 20. Shore surveillance systems; 21. Air EW equipment; 22. Shore and shipboard reconnaissance equipment; 23. Remote sensors; 24. Special purpose electronic equipment (SPETE); 25. Cryptologic equipment. Specifically excluded from 2Z cog is NAVSEA controlled 2F cog major ship electronic equipment.
4A	SPCC	Ordnance and electronic equipments and ordnance repair parts related to NAVAIR.
4G	SPCC	Electronic material to support NAVELEX equipment. Cognizance symbol 4G may include any of the end items applicable to NAVELEX which do not meet the criteria for retention by NAVELEX.
4N	SPCC	Electronic material to support NAVSEA equipments. Cogni-

Cognizance Symbol	Inventory Manager	Description of Material
		zance symbol 4N may include any of the end items applicable to NAVSEA which do not meet the criteria for retention by NAVSEA.
4O	SPCC	Electronic material to support Naval Oceanographic programs.
6G	SPCC	GPETE to support NAVELEX equipments/programs. Consists of GPETE determined by the NAVMAT Command Electronic Test Equipment (ETE) Classification Board to be listed in MIL-STD-1364 and containing the capability, without modification, to generate, modify, or measure a range of parameters of electronic functions required to test two or more systems or equipments of basically different design.

APPENDIX C

Material Control Codes
Applicable to Repairable Material

A Material Control Code is a single alphabetic character assigned by the inventory manager to segregate items into more manageable groupings (e.g., fast, medium, or slow movers) or to relate to field activities special reporting and/or control requirements.

The Material Control Codes (MCC) listed below apply to mandatory turn-in repairable material. (13)

MCC	Explanation
D	Field level repairables (items which generally can be repaired locally, i.e., by an organizational or intermediate level activity.
E	Depot level repairables designated for intensive management under the Improved Repairables Asset Management (IRAM) program. Cognizant inventory managers are SPCC and ASO.
G	Fleet Ballistic Missile weapon system depot level repairables requiring intensive management. Cognizant inventory manager is the Strategic Systems Project Office.
H	Depot level repairables not assigned MCC E, G, Q, or X. Applies to all inventory managers.

MCC	Explanation
Q	Fleet Ballistic Missile weapon system depot level repairables requiring special test, special report, or periodic inspection.
X	Special program depot level repairables.

APPENDIX D

Advice Codes Applicable To Mandatory Turn-in Repairables(13)

Advice Code	Explanation
5A	Replacement certification. Requested item is required to replace a mandatory turn-in repairable which has been surveyed as missing or obviously damaged beyond repair.
5D	Initial requirement certification. Requested item is a mandatory turn-in repairable required for initial outfitting/installation or increased allowance/stockage objective; no unserviceable unit is available for turn-in.
5G	Exchange certification: 1. Requested item is a mandatory turn-in repairable for which an unserviceable unit will be turned in on an exchange basis under the same document number as that used in the requisition; 2. Requested item is a compressed gas for which an empty cylinder will be turned in on an exchange basis.
5S	Remain in place certification. Requested item is a mandatory turn-in repairable for which an unserviceable unit will be turned in on an

Advice Code	Explanation
	exchange basis after receipt of a replacement (serviceable) unit. The turn-in document number will be the same as that used in this requisition.
5V	Initial requirement certification. Requested item is a FIRM (Fleet Intensified Repairables Management) repairable required for initial outfitting/installation in a new construction ship, therefore, no unserviceable unit is available for turn-in.[4]

[4]FIRM is an SPCC program designed to monitor and control the turn-in of specified repairable material.

APPENDIX E

AN/WRC-1 Family Radio Survival Rates

The survival rates for 26 2Z cog equipments and/or major components used in the AN/WRC-1 Family Radio communication systems were obtained for the purpose of relating survival rates to specific 2Z cog items. Survival rates were obtained from the SPCC MDF and also from manual records maintained by NAVELEX. As shown by the difference between the MDF survival rates and the NAVELEX survival rates for the same item, the MDF data are not being updated.

Equipment Nomenclature	NIIN	MDF Survival Rate	NAVELEX Survival Rate
AN/URC-35	00-063-1667	0.85	0.90
AN/URC-35 (w/o mount)	00-100-8003	0.85	0.90
AN/URT-23A Type 1	00-134-0276	0.90	1.00
AN/URT-23A Type 2	00-134-0278	0.85	1.00
CU-938	00-134-1525	0.92	0.95
CU-938A	00-134-1526	0.87	0.95
AM-3924	00-134-5448	0.83	0.90
CU-937A	00-150-2311	0.85	0.95
R-1051E	00-168-9369	0.85	0.95
R-1051D	00-177-2951	0.85	0.90
AN/URC-35B	00-181-5921	0.85	0.95
AN/URT-24A	00-181-5922	0.85	0.95
AN/URT-23(V) Type 1	00-248-2054	0.90	0.99

Equipment Nomenclature	NIIN	MDF Survival Rate	NAVELEX Survival Rate
AN/URT-23(V) Type 2	00-248-2055	0.85	0.99
AN/URT-24	00-411-6144	0.97	1.00
AN/URC-35A	00-411-6145	1.00	0.99
AN/URT-23(V) Type 3	00-450-1664	0.92	0.99
AN/URT-23(V) Type 5	00-450-1666	0.87	0.87
AN/URA-38A	00-486-8589	0.95	0.98
T-827	00-908-6473	0.90	0.90
PP-3917	00-945-2992	0.90	0.92
AN/WRC-1B	00-948-3407	0.92	0.92
R-1051B	00-948-3408	0.92	0.89
CU-937	00-964-9673	0.87	0.95
R-1051	00-964-9675	0.92	0.82
AM-3007	00-973-1068	0.85	0.88

The average MDF survival rate is 0.89.

The average NAVELEX survival rate is 0.94.

APPENDIX F

System Material Availability

The System Material Availability (SMA) data shown below provides a comparative measure of inventory management effectiveness for the majority of hardware related Navy managed material by cognizance symbol. SMA is only a gross measurement of inventory management effectiveness. There are a number of factors (some of which are discussed in the text of this thesis) which must be considered and analyzed before the significance of an SMA can be accurately determined.

The SMA figures shown below are expressed as a percentage. SMA measures the percentage of requisitions which are fully satisfied by supply system stock at the time requisitions are initially processed. Initial processing includes processing by the stock point that first receives a requisition, subsequent referral to the cognizant inventory manager, and referral to other stock points by the inventory manager.

Cog Symbol	FY76	FY7T	FY77	FY78	FY79		
					1st QTR	JAN	FEB
1R	68.5	70.5	73.6	76.3	75.8	77.3	74.6
2R	67.3	67.6	67.1	68.1	69.5	69.0	68.2
4R	72.0	64.2	78.4	73.7	79.3	83.1	62.5
5R	80.5	85.9	81.8	79.0	73.3	79.1	68.4
6R	41.3	66.5	53.3	69.5	55.6	75.4	30.1
8R	69.2	63.5	56.5	53.4	38.8	42.1	43.1

Symbol	FY76	FY7T	FY77	FY78	FY79 1st QTR	FY79 JAN	FY79 FEB
1H	78.9	81.7	79.7	78.7	77.5	79.7	78.9
2H	56.4	58.6	56.1	55.9	53.4	54.1	59.5
8H	63.4	86.6	87.0	95.7	88.3	94.4	86.8
4A	74.1	68.4	70.9	67.9	71.1	64.4	72.7
6A	92.1	93.3	90.0	89.2	91.0	88.2	90.9
6H	93.0	93.7	93.7	91.4	92.6	87.8	90.1
6X	83.4	83.0	81.2	81.6	86.1	90.9	88.9
2U	86.9	83.0	78.0	74.5	67.8	66.7	83.7
4U	73.7	70.2	68.5	65.8	61.1	74.1	73.7
6U	70.4	64.9	69.1	75.9	74.7	75.9	83.7
6E	85.6	89.7	84.4	55.0	89.3	77.3	76.4
4N	73.5	73.7	72.3	70.1	65.2	66.0	73.4
8N	50.7	53.3	42.8	37.6	39.6	43.5	39.1
4G	61.7	63.6	64.6	71.0	68.5	67.7	71.7
6G	36.1	29.5	45.5	54.3	47.0	50.6	49.9
2F	n.a.	n.a.	n.a.	87.1	90.4	93.9	89.4
2J	n.a.	n.a.	n.a.	98.4	97.6	94.8	90.3
2S	n.a.	n.a.	n.a.	92.9	93.2	92.8	95.5
2W	n.a.	n.a.	n.a.	84.0	76.7	96.1	80.4
2Z	88.5[5]	80.0[5]	83.1[5]	79.1	71.6	70.4	76.9

With the exception of footnote 5, these above data were obtained from the February 1979 System Material Availability and ICP MILSTEP Workload Analysis issued by the Financial

---

[5]These figures were obtained from discussions with SPCC personnel who had access to the applicable data records.

Management/Comptroller, Performance Analysis and Evaluation Division, Naval Supply Systems Command.

APPENDIX G

AN/WRC-1 Family Radio Demand Data

Demand data for AN/WRC-1 Family Radio 2Z cog items were obtained from demand data stratifications performed by Hanson (2).

The data presented below include only unplanned requirement (UR) demands. The existence of more than two UR demands for a 2Z cog item can be used to classify it as a secondary type item according to the CNO's definition of principal and secondary items. Two or less UR demands would be within the OPNAV allowance for major damage replacements. Therefore, an item with two or less UR demands could still be classified as a principal item.

The 2Z cog items shown below experienced UR demands over varying time intervals within the period from 1970 through the first six months of 1978. Because the periods in which each item received UR demands varied from item to item, the applicable time period over which UR demand was recorded is shown in the last column.

The equipment nomenclature includes two categories of 2Z cog material:

(1) Equipment comprised of 2Z cog sub-assemblies/components. All of the AN-nomenclatured items are in this category.

(2) Components used in various combinations to form an AN-nomenclatured item. All of the items listed without an AN-nomenclature are in this category.

Nomenclature	NIIN	Total UR Demands	Period of UR Demands
AN/WRC-1	00-964-9674	1	1976
AN/WRC-1B	00-948-3407	214	1971-1977
AN/URT-24	00-411-6144	64	1971-1978
AN/URT-24A	00-181-5922	30	1972-1976
AN/URT-24B	01-053-5291	0	n.a.
AN/URC-35	00-063-1667	22	1971-1976
AN/URC-35 (w/o mount)	00-100-8003	5	1976-1977
AN/URC-35A	00-411-6145	88	1971-1978
AN/URC-35B	00-181-5921	142	1972-1978
AN/URA-38	00-926-0266	188	1971-1978
AN/URA-38A	00-486-8589	324	1970-1978
AN/URT-23(V) Type 1	00-248-2054	8	1974-1978
AN/URT-23(V) Type 2	00-248-2055	0	n.a.
AN/URT-23(V) Type 3	00-450-1664	127	1972-1978
AN/URT-23(V) Type 4	00-450-1667	4	1972-1974
AN/URT-23(V) Type 5	00-450-1666	95	1971-1978
AN/URT-23(V) Type 6	00-450-1665	16	1971-1973
AN/URT-23	00-945-4221	23	1972-1977
AN/URT-23A(V) Type 1	00-134-0276	137	1973-1977
AN/URT-23A(V) Type 2	00-134-0278	20	1973-1977
AN/URT-23A(V) Type 3	00-134-0279	0	n.a.
CU-938A	00-134-1526	22	1975-1978
CU-938	00-134-1525	15	1977
C-3698A	01-014-8882	0	n.a.
C-3698	01-014-8881	0	n.a.
CU-937A	00-150-2311	269	1972-1978

Nomenclature	NIIN	Total UR Demands	Period of UR Demands
CU-937	00-964-9673	769	1971-1978
AM-3007	00-973-1068	9	1976-1977
RT-618A	00-450-1659	0	n.a.
R-1051E	00-168-9369	119	1972-1976
R-1051D	00-177-2951	79	1971-1977
R-1051B	00-948-3408	629	1970-1977
R-1051	00-964-9675	7	1972-1976
T-827F	00-168-9370	1	1977
T-827E	00-168-9621	1	1977
T-827D	00-496-9996	6	1972-1976
T-827B	00-948-3409	7	1971-1977
T-827	00-908-6473	8	1971-1976
PP-3917A	01-067-3774	0	n.a.
PP-3917	00-945-2992	54	1971-1978
PP-3916A	00-334-8403	0	n.a.
PP-3916	00-945-2981	50	1971-1977
MT-4670	01-056-1420	0	n.a.
AM-3924A	01-067-3698	0	n.a.
AM-3924	00-134-5448	22	1971-1977

APPENDIX H

DEPARTMENT OF THE NAVY

Memorandum

DATE 07 DEC 1977
51012:TFM:mhr
Ser 367-510127

FROM: ELEX 510

TO: ELEX 504

SUBJ: AN/WRC-1 Family, Stock Coordination Review Program

REF: (a) ELEX memo 50423/MAD ser 456 dtd 11 Nov 77
(b) NAVMATINST 4440.37C

1. Reference (a) provided Stock Coordination Worksheets for AN/WRC-1 Family items and requested data and coding recommendations. Reference (a) also indicated that recommendations for retention of specific items require detailed supporting justification, based on the criteria of reference (b).

2. It is recommended that the WRC-1 Family equipment be retained based on criteria a(3) of reference (b), i.e., items unstable in design. On-going programs affecting the design of various AN/WRC-1 Family equipments are as follows:

a. CNM DART Program: Both AN/URT-23 and AN/URA-38 are DART items. A DART requirement to more than double the current MTBFs of these equipments will result in development of design changes over the next two years. (In addition, a DART requirement to replace existing AN/WRT-2s with AN/URT-23s, and CNO direction to complete this effort ASAP, will require special inventory management control.)

b. Low Cost Link 11: This is an OP-35 sponsored program to modify AN/URT-23 and R-1051 for use in Link-11 systems. The modifications are currently being developed and will be incorporated in a future WRC-1 Family contract.

c. Classified improvement program: ELEX 310 is investigating a separate classified effort relating to the AN/URT-23. A contract award in this area will be made in this FY.

d. 500/100 Hz Conversion: An existing CNO directive on this subject is now being pursued by CNO with the possibility of updating some or all 500 Hz incrementally-tuned equipments by 1980. This would affect AN/URT-23s, AN/URT-24s and R-1051s.

e. Field Change Program: There are twelve (12) field changes, applicable to various WRC-1 Family equipments, presently programmed for development thru FY-80. These will require redesign of the existing equipments.

f. Semiconductor Update Program: Problems in acquiring germanium semiconductors are resulting in continuing redesign of existing circuits. This has been done for all new equipments (FY-77), and the results will be applied by modifications to be developed for earlier versions.

g. Interchangeability: A major logistics advantage of the WRC-1 Family is the modular interchangeability existing between the 20,000 various type equipments now in use. Application of the changes outlined in (a) thru (e) must be done throughout the Family consistent with existing interchangeability.

3. Based on the foregoing, it is strongly recommended that inventory control and technical cognizance of the WRC-1 Family be retained until completion of the cited programs and development of a technical package incorporating the changes resulting from these programs. It is expected that this can be accomplished in FY-80.

C. [illegible]
CAPT, USN

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